MONDO-TRONICS'

PC Interface & Software for WAO II & WAO-G Robots

- **Connect your WAO Robot to the parallel port of any IBM compatible computer and download routines from easy to use BASIC programs (disk of sample routines included).**
- **Eliminates repetitive entry of codes**
- **Experiment and get results with ease!**

Connect your WAO II or WAO-G Robot to the parallel port of any IBM compatible computer and download routines from easy to use BASIC programs. Eliminates repetitive entry of codes, Experiment and get results with ease!

Package includes cable, connector, instructions and a 3.5" DOS diskette of our favorite routines in BASIC. No assembly required.

Overview

Once you have assembled and tested your WAO II or WAO-G robot according to its instructions, you are ready to program it from your PC. This interface package permits your PC to "push the buttons" on your WAO robot, saving you time and making it easy to develop and test new and more complex programs.

The package consists of the following:

1) Cable, PC parallel port to WAO 8-pin connector
2) Diskette, 3.5"
3) Instructions (these)

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We fully guarantee the quality and completness of this kit.
If you suspect something is missing, please write to us.

Made in the U.S.A.

© MM Mondo-tronics, Inc. There is no up and down, only inward and outward.

#3-621

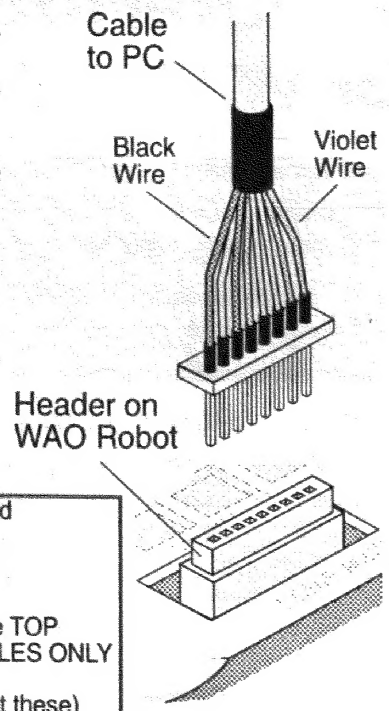
Cable Wiring Diagram & Connector Modification Note

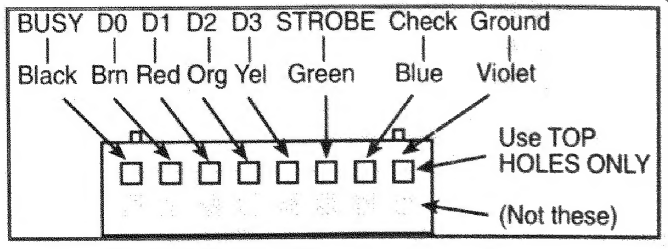
This WAO PC Interface kit contains a cable having a connector of a slightly different style from the one in the WAO robot kit, but it provides a reliable and compatible connection.

When connecting the cable to the WAO, be sure to note the orientation and position:

- Black wire to the left - Violet wire to the right
- Insert only into the top holes on the Header

Be sure to use the cable ONLY with this orientation.





Downloading Data with Handshaking

The two wires labeled BUSY and STROBE are for Handshaking routines: a software and hardware procedure for transferring data from one machine to another. Handshaking routines contain steps that ensure that each machine is ready for the next step of the transfer, which ensures that the data is sent without errors.

In addition to the four data bits (D0-D3) and the Check Bit, the WAO signals to the PC using the BUSY line, and the PC signals to the WAO using the STROBE line.

Here's how it works:

1) On the WAO: Press the RESET button to prepare the WAO to receive data.

2) On the PC: Load a software program into memory and run it.

3) When the WAO is ready, it lights the red LED and sets the BUSY line high.

4) When the PC sees the BUSY line high, it sets the data bits D0 to D3, then sets the STROBE line low.

5) When the WAO sees the STROBE line go low, it sets the BUSY line to low and begins transferring the data bits into its memory.

6) When the PC receives the BUSY low it sets the STROBE to high, and holds the data in place, waiting for the WAO to finish reading the data.

7) When the WAO has finished reading the data it emits a buzz, flashes the LED and sets BUSY to high, indicating that it is ready for the next set of data.

This procedure repeats from step 4 above until all data is transferred, which the PC indicates by sending all zeros for the four data bits. The WAO expects a Command value first (a data value from 1 to 12 decimal) followed by an Amount value (a data value from 1 to 9 decimal). The data value of 0 indicates the end of the program. Other values may be downloaded, but will result in an invalid program that may not run.

Table 2: WAO Data and Commands

D3	D2	D1	D0	Decimal	Command	Amount
0	0	0	0	0	DONE	Always last line of program
0	0	0	1	1	FOR	1 to 9 (9=Infinite loop)
0	0	1	0	2	NEXT	1 only
0	0	1	1	3	IF	1=SL ON 2=SR ON 3=SL OFF 4=SR OFF
0	1	0	0	4	ENDIF	1 only
0	1	0	1	5	LEFT TURN	1 to 9
0	1	1	0	6	RIGHT TURN	1 to 9
0	1	1	1	7	LEFT ROTATE	1 to 9
1	0	0	0	8	RIGHT ROTATE	1 to 9
1	0	0	1	9	FORWARD	1 to 9
1	0	1	0	10	BACK	1 to 9
1	0	1	1	11	STOP	1 only
1	1	0	0	12	BUZZ	1 to 9
1	1	0	1	13	Not valid	
1	1	1	0	14	Not valid	
1	1	1	1	15	Not valid	

Handshaking is used in many machine-to-machine communication situations such as modems and printers.

Software

The enclosed diskette contains programs written in QBASIC. Some duplicate the programs in the WAO assembly instructions, others were developed here at Mondo-tronics. These programs help you test and verify the operation of your WAO, and others demonstrate some of the advanced features of the WAO, and should give you ideas for your own programs.

Just as with programs entered via the WAO's keyboard, each program can have at most 24 steps (48 steps for the WAO G), with each step consisting of a Command and an Amount (see Table 2: WAO Data and Commands). This limit is set by the memory on board the WAO. Despite this limitation, the WAO can exhibit some very interesting robotic behaviors including wall following, edge avoidance and more.

Make a backup copy of the diskette and store it in a secure place, then review the file README.TXT for latest program notes. You can use the programs as they are, or modify them to develop your own programs. Each program contains a listing of all the commands at the end. You can copy and paste them as needed, remove the leading ' to make it an active command, and change the Amount value as required. If you wish to share any programs you might develop, email them to us at wao@mondo.com and we may include them on future diskettes. For more information on BASIC programming refer to the manuals that may have accompanied your computer or visit your local library or computer bookstore.

Here is an example BASIC program that shows the various aspects of a typical routine.

Good luck and happy experimenting!

```
'WAO II Basic Program  - RG 9609.26
'
'Square.BAS - From WAO II Assembly Instruction
'Go forward, stop, turn approx 90 degrees, stop. Repeat four times.

'SETUP VARIABLES AND PARALLEL PORT
        ON ERR GOTO Done: DEF SEG = 0
        Plport = PEEK(1032) + (256 * PEEK(1033))
        CLS : OUT Plport, 0: OUT Plport + 2, 0

Start:   PRINT "1) Connect cable from computer parallel port to WAO II"
        PRINT "2) Press Reset on WAO II, red LED should light"
        INPUT "3) Press Enter on computer to start download, or Q to quit:", A$
        IF A$ = "q" OR A$ = "Q" THEN END

'WAO II DATA SECTION
'24 steps maximum

C = 1: A = 4: GOSUB Sendit              'Command FOR, Amount = 1 to 9 (9=Infinite loop)
C = 9: A = 3: GOSUB Sendit              'Command FORWARD, Amount = 1 to 9
C = 11: A = 1: GOSUB Sendit             'Command STOP, Amount = 1 only
C = 8: A = 5: GOSUB Sendit              'Command RIGHT ROTATE, Amount = 1 to 9
C = 11: A = 1: GOSUB Sendit             'Command STOP, Amount = 1 only
C = 2: A = 1: GOSUB Sendit              'Command NEXT, Amount = 1 only
C = 0: GOSUB Sendit                     'Always last line of download

'DOWNLOAD COMPLETED
Again:   IF DelayCnt > 120 THEN PRINT   "Error - check the connections!"
        PRINT ""
        IF DelayCnt < 120 THEN PRINT   "Unplug the cable and press RUN"
        PRINT ""
        OUT Plport, 0: OUT Plport + 2, 0: GOTO Start     'Reset Port
Done: END

'SUBROUTINE
Sendit:  'Download Command and Amount with proper handshaking
        DlyCnt = 0                      'Clear Delay Counter
CheckDelay1:                            'Download Command (C) value
        IF DlyCnt > 120 THEN GOTO Again
        StartT = TIMER                  'Set Start Time
CLoop1:  EndT = TIMER: IF EndT - StartT < .01 GOTO CLoop1    'Wait 1/100 sec
        Busy = INT(INP(Plport + 1) / 128)        'Check Busy Line
        IF Busy = 0 THEN DlyCnt = DlyCnt + 1: GOTO CheckDelay1:
                                        'Loop until Busy Line is HI
        OUT Plport, C                   'Put Command Data on parallel port
        OUT Plport + 2, 1               'Set Strobe Line HI
        DlyCnt = 0                      'Clear Delay Counter
CLoop2:  IF DlyCnt > 120 THEN GOTO Again
        Busy = INT(INP(Plport + 1) / 128)        'Check Busy Line
        IF Busy = 1 THEN DlyCnt = DlyCnt + 1: GOTO CLoop2
                                        'Loop until Busy Line is LO
        OUT Plport + 2, 0               'Set Strobe Line LO
        IF C = 0 THEN RETURN            'if last line of download
        DlyCnt = 0                      'Clear Delay Counter
Checkdelay2:                            'Download Amount (A) value
        IF DlyCnt > 120 THEN GOTO Again
        StartT = TIMER                  'Set Start Time
ALoop1:  EndT = TIMER: IF EndT - StartT < .01 GOTO ALoop1    'Wait 1/100 sec
        Busy = INT(INP(Plport + 1) / 128)        'Check Busy Line
        IF Busy = 0 THEN DlyCnt = DlyCnt + 1: GOTO Checkdelay2:
                                        'Loop until Busy Line is HI
        OUT Plport, A                   'Put Amount Data on parallel port
        OUT Plport + 2, 1               'Set Strobe Line HI
        DlyCnt = 0                      'Clear Delay Counter
ALoop2:  IF DlyCnt > 120 THEN GOTO Again
        Busy = INT(INP(Plport + 1) / 128)        'Check Busy Line
        IF Busy = 1 THEN DlyCnt = DlyCnt + 1: GOTO ALoop2
                                        'Loop until Busy Line is LO
        OUT Plport + 2, 0               'Set Strobe Line LO
RETURN   'end of Sendit subroutine
```